

# Low Vision Aids

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**Abstract:** *Visual impairment is a challenging problem in worldwide, Low vision impair the social life of patients. Low vision aids can improve patient's social life. With availability of newer electronics, are increasingly being used as low visual aids. Due to lack of awareness about low vision aids in practitioners as well as patients remain a barrier. Hence in this article we outline the details of various low vision aids and proper use.*

**Keyword:** Low vision, Low vision aids, Vision loss

## 1. Introduction

As per the International Statistical Classification of Diseases and Related Health problems (ICD-10) published by World Health Organization (WHO), visual disturbance and blindness is classified as H53-54.9. Low Vision (Visual impairment Categories 1 & 2) is defined as "A person with low vision is one who has impairment of visual functioning even after treatment, and/ or standard refractive correction, and has a visual acuity of less than 6/18 to light perception or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task for which vision is essential". Blindness (Visual impairment Categories 3, 4 & 5) is defined as visual acuity of less than 3/60 or a corresponding visual field loss of less than 10 degrees in the better eye with best possible correction. The term visual impairment includes both blindness as well as low vision [2].

Visual impairment is a pressing public health challenge, with blindness being one of the most common disabilities world wide [3]. Globally, the number of people of all ages visually impaired is estimated to be 285 million, of whom 19 million are children [4]. The burden of childhood blindness may not seem to be large in number, but it is the second largest cause of blind-person years worldwide (following cataract).

Low vision impairs the social life of patients. Low vision aids can improve patient's social life [5, 6]. With availability of newer electronics, are increasingly being used as low visual aids. Due to lack of awareness about low vision aids in practitioners as well as patients remain a barrier.

Lack of awareness among eye care practitioners about low vision management remains a barrier in the use of low vision [7-11]. Thus, in the wake of the changing trends in the management for low vision, we discuss about the current management options for low vision in this review.

### Low Vision Rehabilitation

Quality of life is reduced in low vision person. Thus, the purpose of low-vision rehabilitation is to improve quality of life with increasing social interaction by optical/non-optical devices.

### Low Vision Aids

An optical/non-optical device that improves or enhances residual vision by magnifying the image of the object at the retinal level.

Rehabilitation depends to the type of visual loss and also on individual's choice or expectations. Reading has been identified as the most common problem in patients with low vision [12]. Improvement in reading for distance as well as for near has been reported using optical aids in several studies [13].

Indications for low vision-

**Children:** Albinism, ROP, Congenital malformation, Optic neuropathy.

**Young Adult:** Keratoconus, Ocular injuries, Late manifestation of congenital malformation.

**Old age:** Glaucoma ARMD Diabetic maculopathy Macular degeneration Retinal degeneration, Chorioretinitis, Optic atrophy, myopic degeneration.

### Types of devices-

- 1) Optical
- 2) Non-optical

**Basic Principle Optical-** Optical LVAs are based on the fact that with sufficient magnification; the normal retina surrounding the damaged central retina can be used for central vision.

### Optical LVA:

Magnifying spectacles

- Hand magnifiers
- Stand magnifiers
- Telescopes
- Other optical devices

### Magnifying Spectacles-

#### Optical Principle

Magnification by a convex lens is obtained by bringing the object within its focal length. An erect, virtual and magnified image is produced. High plus lens monocular or binocular with magnification is 1/4th the power of the lens is used to magnify the images. Suited for near and intermediate distance.

Instructions for use – patient should be instructed to hold the material very close and then move it out and scan the lines one by one. Light must be properly adjusted.

#### Advantages

Cosmetically acceptable, more comfortable, both hands are free to hold the reading material. Simultaneous both near and distance vision with large field of vision.

#### Disadvantage

Spherical aberration and illumination problem  
Close reading distance due to higher power causes fatigue and unacceptable posture.

Patients with eccentric fixation are unable to fix through these.

#### Hand magnifier-

Indicated for spot or short-time tasks in patient with field of vision reduced to 10' or more for near vision. Available from + 4.0 to + 40 D.

Instructions for use –The patient should be shown how to put the magnifier flat on the reading surface to begin with and raise it until the image is clear and distorted.

#### Advantages:

- Working distance is more and accommodation is not required.
- Easy to manipulate for viewing eccentrically, some have light source which further enhances vision.

#### Disadvantages:

- It occupies both hands and need to be held at the correct distance.
- Not useful in absence of manual dexterity and field of vision is limited as compared to spectacles.

**Stand magnifier-**Forms a virtual image a short distance behind the lens has a fixed focus.

The patient needs to place the stand magnifier on the reading material and move across the page to read.

Instructions for use –the patient should be taught to place the stand magnifier flat on the reading material, and look at the image through reading glasses or bifocals to converge the divergent rays coming from the magnifier lens. Because of the reduced aperture of these magnifiers the eye must be closer to lens surface to obtain the full width of the reading field.

#### Advantages

They are a choice for patients with tremors, arthritis and constricted visual fields with technically simple.

#### Disadvantage

- Small field of vision and difficult to use if the surface is not flat (14).
- Too close reading posture is uncomfortable for the patient.

**Bar magnifier-** It contains plano-cylindrical lens. Magnifies the height of the letter which becomes readable. Lies flat on the page, elongates the letter but don't separate them, magnifies in the vertical meridian only.

#### Advantages

Person with small central field who needs minimum magnification are benefitted.

#### Disadvantage

Available in low magnification power range 2 to 3.5D only.

#### Telescope

They magnify the apparent size of distant objects, making them appear closer to the patient. The magnification ranges from 2x to 10x. The patient has to spot the object he wishes to see and then brings the telescope in front of the eye. The optics of the telescopic systems is based on two basic principles- Galilean or Keplerian. It could be hand-held, Clip-on/spectacle-mounted or abioptic design.

#### Advantages

- One of the most popular device to enhance distance vision.
- Can be used in classroom for blackboard reading or reading traffic signals, street signs, bus numbers.

#### Disadvantages

Major drawback is the restriction in the field of view. Focusing requires good hand-eye coordination.

**Bioptic telescope-**It magnifying up to six times, which can be embedded into the spectacle glass. It allows the wearers to switch their sight between their regular vision and the magnified vision of the device by just a slight tilt of the head, similar to how one uses bifocal spectacles. Several recent studies have highlighted the effectiveness of bioptics for driving among the visually impaired patients. However, the evidence regarding the safety and efficacy of bioptic driving is still unclear, and laws surrounding it are ambiguous. Bioptic telescope use is legalised conditionally in some provinces in United States, Canada and The Netherlands. (14)

#### Others Optical Devices for Low Vision

Absorptive lenses –reduce glare and dark adaptation time.

Tinted lenses-Low absorptive high transmissions are best for constant use  
Photochromatic lenses- Use for light sensitive person. (15)

Filters – Contrast can be enhanced by using spectacles with yellow and amber filters.

Polarization-reduce glare.

Visual field enhancement devices: Fresnel prism ---retinitis pigmentosa.

Central scotomas and eccentric viewing -prism incorporated into reading glasses by diverting the light.

#### Non-optical devices:

- Approach magnification
- Illumination
- Contrast enhancement
- Increased size object
- Electronic magnifiers (CCTV, LVIS, V-max)
- Writing and communication devices
- Orientation and mobility LVAs

#### Approach magnification-

Partially sighted patients should be encouraged to move as close as possible to the object.

#### Illumination

##### a) Higher levels of illumination is required:

- Macular Degeneration
- Glaucoma
- Diabetic Retinopathy
- Retinitis Pigmentosa
- Chorioretinitis.

##### b) Reduced illumination is required in Albinism and aniridia.

##### c) Positioning-To the side of better eye or moving light closer.

##### d) Contrast Enhancement-Using a typoscope or contrast modification of visual environment

##### e) Relative size devices-Large print material

- Enlarged clocks, telephones,
- Calendars, computer keyboards
- Large type playing cards.

#### Electronic magnifiers

#### Close-circuit television

CCTV consists of a monitor, a camera, a table or a platform where the reading material can be placed. It has controls for brightness, contrast, colour and magnification. Magnification can be varied from 3x to 70x. Current video magnification systems include:

- Desktop CCTV with enhanced features (autofocus, speech commands, flat screens, text manipulations).
- Handheld cameras/portable devices.
- Head mounted systems where camera and LCD displays are combined in a single unit.

#### Advantages:

- Higher magnification up to 70x with binocularity.
- Patient can sit at comfortable reading distance.
- Hands are free for writing, etc.

#### Disadvantages

Expensive, need more training and practice.

#### Computer Education Software

- JAWS screen Reading software: It converts a normal personal computer into a talking computer so that one can learn to operate the computer independently.
- Connect out load internet and e-mail software: Access to internet through speech and braille output.
- MAGic 8.0 screen magnification system with Speech: It has a magnification range of 2x to 16x and it also reads the information aloud.

#### Portable Electronic Low-Vision Aids-

Interest is increasing among the patients and the physicians in portable electronic low-vision aids. Some of these devices are Optelec Compact+, Optelec Compact 4HD, Schweizere Mag43, and Eschenbach Mobilux Digital, Aumed –EYE-C.

In a prospective randomized crossover study, portable electronic vision enhancement system devices were found to be cost-effective for improving near vision visual function.

One portable artificial vision device (OrCam) is an optical character recognition device, capable of recognizing text, monetary denominations, faces, and can be programmed to recognize other objects. It consists of a miniature camera and an earpiece that can be mounted on the spectacle frame. When activated OrCam can click pictures and even read aloud any text found on the pictures that can be heard by the user via the earpiece.(16) The Or Cam was recently made commercially available in the United States and its usefulness has been elucidated in a recent study.(17)

#### Smart Phone/ Tablet/ Electronic Readers

With a widely available internet access, internet-ready devices like smart phones and tablets are being commonly used worldwide and off late are being increasingly used as visual aids. These devices are incorporated with features of image enlargement, high contrast screens, invert colors and bespoke apps. The textural characteristics like font size, format, word spacing, line spacing, color can also be manipulated. Several recent studies have shown that with proper training these devices can be a valuable tool for low vision patients especially as a reading aid [24-26]. Another exciting ongoing development is the Google glass technology and research is on way for its use in cases of visually impaired.

Some examples of mobile friendly low vision apps: -

- Claria Zoom- Easy to see interface for the visually impaired. Such as-big characters and color themes

- Low Vision Clear Sight – Multi-featured application for low vision having options to view enlarged contacts, camera, calculator, clock and GPS with bold color themes
- Eye – D – for visually impaired it is intelligence based smart phone assistant app. It helps user to be location aware, explore and navigate to nearby places of interest.
- Zoom Plus Video magnifier – it enlarges text and allows changing colors and contrast of the text and background like video magnifier.
- Macular Society, Low Vision keypad free, blind and senior music player etc. are few more which can be used.

#### Writing and communication devices

- Writing guides
- Signature guides
- Check guides
- Tactile or raised line papers

#### Sensory Substitute Assistive Device

- Auditory substitutions -Talking books
- Tactile substitutions-Braille

#### Mobility assisting devices

Patients with low vision suffer a major problem of mobility

- Long canes
- Strong portable lights

#### Medical Management and life skill devices-

Examples of such devices are –

- Pre-set insulin syringe: the patient feels the pre-set level notes and knows how much to inject even if he is not able to see the markings.
- Notex: scientifically accepted device for currency identification
- Needle threader: it helps in easy threading.
- Talking clock and watches: these are readily available in the market at low cost. They have raised buttons with speech output option

#### Why to prescribe

The prescription of low vision devices gives the person- Independence and increase adaptation to the daily activities material.

It constitutes an important factor for socioeconomic and cultural integration, exposure to enriching experiences.

#### How to prescribe

A careful clinical history is important to setting goals based on real expectations. A person who participates in selecting the aid is more likely to learn how to handle it.

How to prescribe Optical Devices –

Determine the best corrected VA for near/ distance.  
Determine the visual acuity that the patient requires.  
Calculate the magnification needed to achieve the goals:

It is important to consider that with VA of 20/50 (0.5log Mar) the person can perform most of the daily tasks. In this way, the Kestenbaum rule can be applied, in which the magnification is given by the inverse of the VA in diopters ( $A=1/ VA$ ). To achieve the power of hand or stand magnifiers and telescope divide the value found in diopters by 4 (unit of magnification), for example:

$$VA = 20/200$$

$$A = 200/20 = 10 \text{ D}/4 = 2.5 \text{ X}$$

When you have a defined goal, the magnification proposed can be achieved by dividing the desired VA for the observed VA for example:

$$VA = 20/160, \text{ desiring to achieve } 20/20$$

$$A = 160/20 = 8\text{X}$$

Select the aid according to the characteristics of the device: the needs, goals, and clinical aspects of the patient.

To achieve better acceptance of any aid, consider the person needs, goals, and ability to handle the aid, as well as the esthetics, weight, cost, and timing of prescription. It is important for the person to be comfortable with the aid proposed.

For reading activities, besides achieving vision for certain size of optotype, the child should be evaluated for reading. In the presence of eccentric fixation or difficulties with proposed aid, training should precede prescription.

Each category of visual device has its advantages and disadvantages. In low vision daily practice, it is common for a child to have more than one aid.

The patient should be monitored frequently to evaluate the effective use of the aid prescribed and difficulties presented in daily activities and to set up more advanced goals.

#### When to prescribe –

Optical aids for near vision are introduced when the reduction of the distance between the object and the eye does not allow the necessary range or when the accommodative effort is too large.

At school age, with VA up to 20/ 200, reducing the distance between the object and the eye is recommended until the second grade. From this stage, a stand magnifier or a hand magnifier can be used for reading small – print books such as dictionaries.

For VA less than 20/200 (0.1 log Mar), optical aids should be prescribed earlier if the VA is less than 20/400 and central scotoma greater than 30 degree, a video magnifier is indicated.

For VA equal to or less than 20/800 aids such as Braille and computer sound system should be included, with or without other resources. Orientation and mobility technique should be encouraged at all low vision level.

When a telescope is first prescribed, a manual, monocular telescope with lower magnification is recommended. The telescope can be prescribed for reading blackboards, and later to use constantly at far. It is important to let the child experiment with the telescope in different situations.

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